CCD-PHOTOMETRY OF THE T TAURI STAR DI CEP

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IWe have presented results of new CCD photometric BVRcIc observations of the classic T Tauri type star DI Cep, which was carried out at the 60 sm reflector of ShAO for 2016-2018 years. Our new results were confirming seasonal periodical brightness variations, which were discovered by us earlier. On the analysis of different group of points we have discovered some seasonal shift for the 9-day period phases. This even can be explained by migration of the active regions on the stellar surface.

Keywords: stellar activity–photometry–Pre-Main sequence stars– individual: DI Cep.

1. INTRODUCTION

DI Cep is a typical CTTS with spectral type G8V-G8IV that displays most of the characteristics of this class of stars [1, 2]. It displays strong emission lines and an excess of continuum emission, both variable in time scales of days [3, 4]. Occasionally short-time scale variability has been observed photometrically [5] and spectroscopically [6]. More recent estimates for the stellar parameters give R = 2.5 Rsun, L = 5.1 Lsun [7], locate it at 300 pc (Kholopov 1959), and give AV = 0.24-0.9 [7, 9].

The spectroscopic data reveal the period P = 9.24 days [10, 11]. Data from different authors show the nine-day quasiperiodicity in the brightness variations fairly reliably, although the period cannot be derived from the entire master set of photometric data. The period P = 18.28 days is also derived from the V brightness. [10] find variations of the zero epoch of the nine-day period, possibly due to the changing location of an accretion disk hot spot.

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In this report we have presented new results of seasonal CCD photometric observation s of the DI Cep.

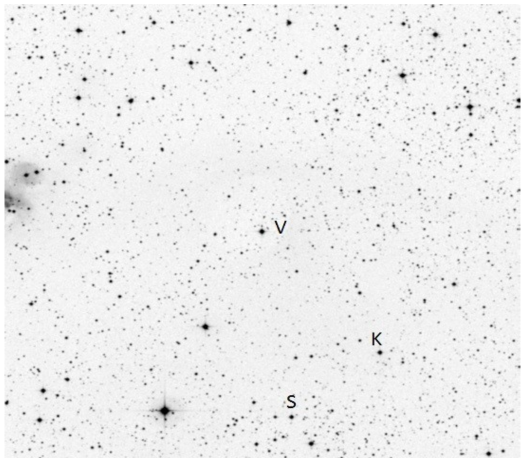

Fig. 1. The frame of DI Cep area. V-variable, S-standard, K-is the check star.

2. OBSERVATIONAL DATA AND RESULTS

Our observations were carried out on the Cassegrain focus of the Zeiss-600 telescope by using a single-channel photometer operating with a set of standard BVRIc filters. A detailed description of the technical characteristics of the system telescope + photometer was given in [16]. In our observations, a CCD FLI 4096×4096 was used. The working field of the frame was 17 arcminutes. We are tried keeping the observational objects and standards closer to the center of the frame. The accumulation time in different filters ranged from 30 to 90 seconds. Such a choice of timing of the accumulation was bound partly due to the uneven behavior of the clock mechanism of the telescope. 5 frames were received in each filter, the maximum accumulation signal for software star and standards made up 30000-40000 ADU. To increase the signal-to-noise ratio S/N, the obtained frames were summed over individual filters. The summation was also carried out for a flat field, a dark signal and frames of bias. For 2016-2018 years we have obtained 36 points, as one point in per night for each filters. In the Figure 1 is shown a frame of the area of the star DI Cep. Here the designations are: V-variable, K-control star, S-standard. For the selection of the star with the most stable brightness and for further use as a standard and control stars, trial combinations were performed. Wherein, at first one star was used as a standard, the rest were determined relative to it. Then the standard stars were replaced by other stars of

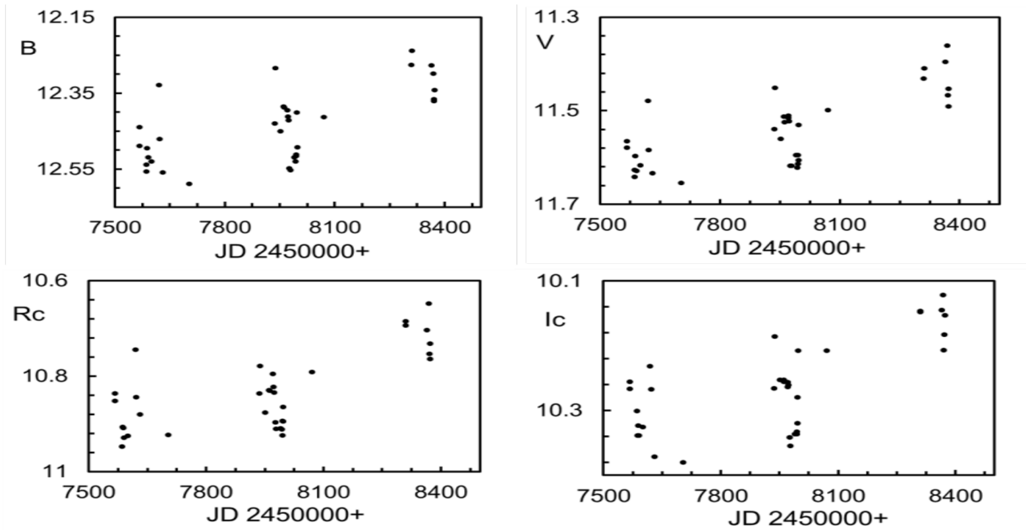

Fig. 2. Light curves of the star DI Cep in three seasons of observations for all filters.

the field and the magnitude of the relatively new standard was again determined. In conclusion, the star that gives the smallest value of the standard deviation of the magnitude in this band was chosen as the standard. Our data for 35 individual nights of observations showed a standard deviation from the average for different filters, the following values for standard and control stars: σR = ±0.018 mag, σB = ±0.015 mag, σV= ± 0.021 mag In the Fig.2 is shown the light curves of the star in all filters for 3 observational seasons 2016-2018. As can be see from here, mean value of brightness of the star are increased from year to year from 11.6 mag to 11.4 mag in V-band. But seasonal variations in separate filters are riches more than 0.3 mag in various filters.

As can be see in Fig.2 we have observed seasonal variation in wide range. We used a period of P = 9.24 days to test for its existence in the light variations. The search was performed according to the data obtained for the year of observations, as well as for the weight of the observation period. Phases was calculated on the elements

$$MinV = JD2457704.2407 + PE$$

Our analysis showed that some times but not in all time we can clear detect the periodical variability on the season data. In the Fig3. we have presented examples of phase light curves for different seasons. As can be seen from this figures, in each case we have signs of the existence of a 9 day period for all seasons.

However, on separate dates a stochastic component of brightness changes is detected, which significantly distorts the picture of a sinusoidal variation. In ad-

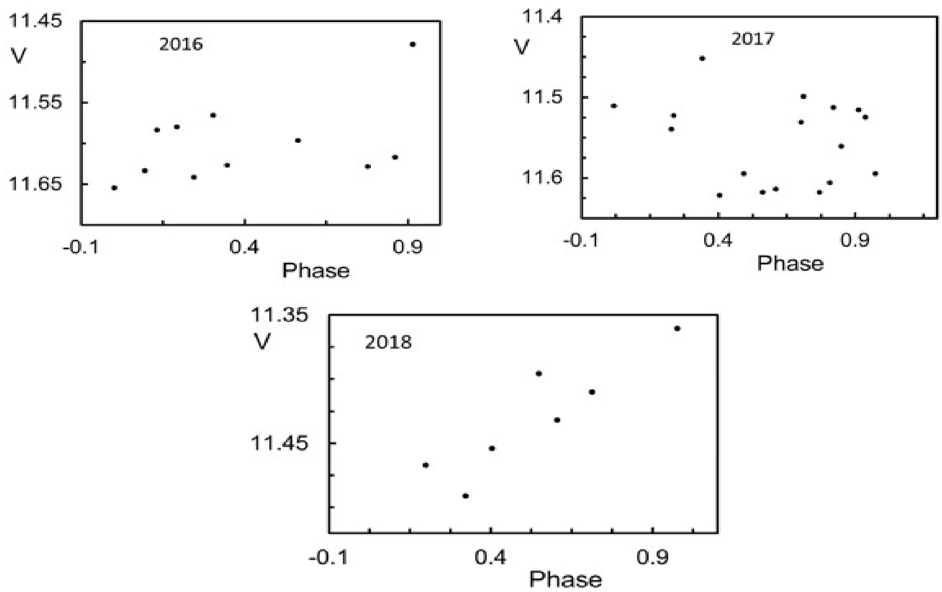

Fig. 3. Phase light curves of DI Cep in V –band for different seasons.

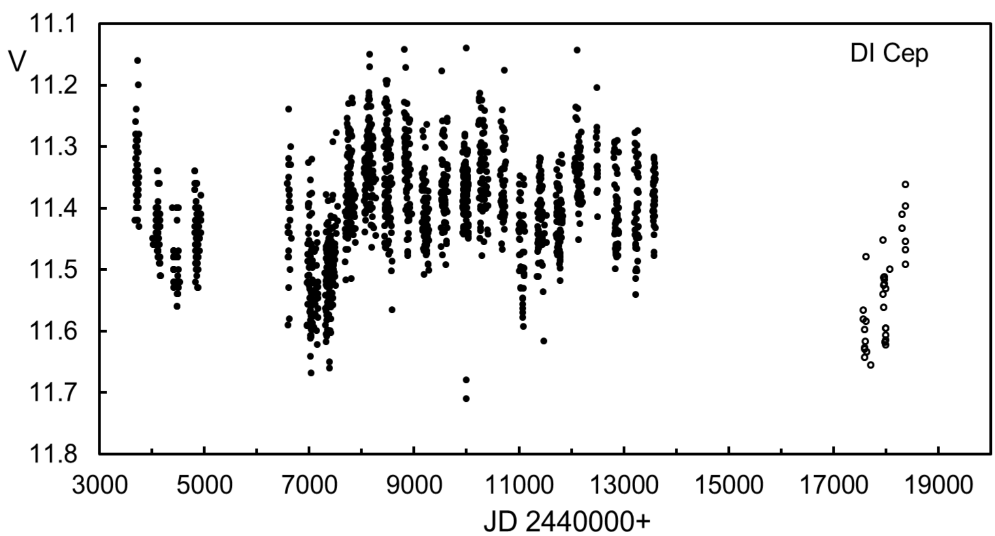

Fig. 4. Master V-light curve of the star DI Cep for nearly 50 years of observations. Open sycles are our observations, dark points - from archive.

dition, we observed a change in the phase of the minimum and maximum of the star's light curve.

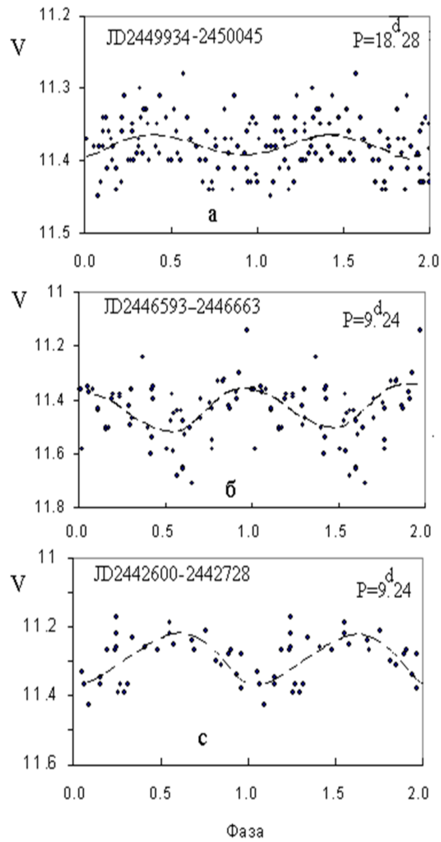

Fig. 5. Phase diagrams in V-band for the periods 18 and 9 days obtained on the archive data [10].

In the Fig.3 the master light curve in V band was shown. Open cycles is corresponding to our observations, black points the results which was obtained from photometric data base [2, 13].

3. CONCLUSIONS

Our photometric observations showed that against the background of significant seasonal changes in brightness, 9-day cyclic changes are detected. This confirms our previously obtained result on the periodic change in the brightness of the star with a period of 9.24 days.

For the period 9.24 days a phase shift is observed over different seasons, which can be explained by a change in the location (migration) of the spots on the surface of the star.

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